Perspectives in Education 2013: 31(3)
ISSN 0258-2236

http://www.perspectives-in-education.com

Research tensions with the use of timed numeracy fluency assessments as a research tool

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In this paper, we describe how we came to use timed fluency activities, along with personal learner reflections on those activities, in our after-school maths club as a complementary research and developmental tool for assessing the changing levels of learners' mathematical proficiency over time. We use data from one case-study after-school maths club. Not only did the activities provide us as researchers, and mentors, with a quick way of tracking, evaluating, encouraging and valuing learner progress, but also with a mechanism for the learners to practise the fluency they were developing through other activities of the club. More importantly, the use of learner reflections assisted learner buy-in and reduced the stress related to such timed assessments. This alleviated, to some extent, our ethical unease with the use of such instruments. We have subsequently extended this research and development tool in all clubs that we run and continue to research their affect and effect in order to gain deeper understanding of the research and development opportunities enabled by such activities.

Keywords: Fluency, elements of fluency, timed assessments, after-school maths clubs, learner reflections, research tool, developmental tool

Introduction

The South African Numeracy Chair (SANC) project focuses on a dialectical relationship between research and development in the field of Foundation Phase numeracy education in the Eastern Cape. Our research remit is to grow an area of research that looks towards finding sustainable solutions to the many numeracy education challenges faced in our province. Developmentally, we aim to improve both the quality of teaching of in-service teachers and learner performance in schools as a result of quality teaching and learning. Our teacher development programme, Numeracy Inquiry Community of Leader Educators (NICLE), works with a core of 43

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participants and runs alongside other learner-focused activities which foreground the importance of numeracy as well as creating a 'maths is fun' ethos in schools.

A key strand of our development work is after-school maths clubs. In 2011, we piloted an after-school maths club in one project school and, following that, began a number of new clubs in 2012. Graven (2011) has argued that after-school maths clubs hold the potential to address some of the challenges young numeracy learners face. Numeracy clubs are conceptualised as communities where sense making, active mathematical engagement and participation, and mathematical confidence building are foregrounded. The conceptualisation of these clubs and the pilot findings have been elaborated in previous work (Graven & Stott 2012).

The first author is a full-time doctoral fellow and intern (responsible for co-ordination of clubs) in the SANC project led by the second author. Two Grade 3 clubs form the case studies of the first author's research which seeks to answer two questions: How do learners' mathematical proficiency levels evolve (if at all) over the period of participation in the maths club; and what is the nature of the mediation that enables this evolving mathematical proficiency during participation in the club? This paper is based on data gathered with regard to the first question in one of the two case study clubs. While a range of tools are used to gather data for this question, here we focus on timed fluency assessments and their value for quick, on-going data collection.

Our development project works towards improving mathematical proficiency among learners and bases its notion of proficiency on Kilpatrick, Swafford and Findell's (2001) definition which comprises five intertwined and interrelated strands of *Conceptual Understanding, Procedural Fluency, Strategic Competence, Adaptive Reasoning and Productive Disposition*. In our clubs, we see many instances where learners are not working with all these proficiencies because they are constrained by their lack of basic foundational mathematical knowledge. For example, in the pilot club in 2011, we noted that the majority of the learners were weak on number bonds. The bonds of 5 and 10 were not recalled automatically and learners used counting on by ones or their fingers to work out, for example, the answers to 2 + 8 or 2 + 98. Their grasp of basic number sense and basic bonds was limited severely and few of the learners seemed to have strategies other than using their fingers to solve problems. This meant that, although they were largely accurate, they were slow at arriving at an answer to a particular problem. We have observed the same issue in subsequent clubs.

As many mathematics educators note (e.g. Askew 2002; Bobis 2007; Burns 2007), children should be encouraged to use a variety of strategies for solving mathematical problems so that they learn when to apply different strategies for different problem-solving scenarios. Burns (2007) notes that if learners think there is only one correct way to work out something, they will focus on learning how to apply that single method, rather than thinking about what makes sense for the numbers they are working with. In our clubs, we observed that some learners were indeed capable of

using a variety of mental strategies, some more sophisticated than others. However, often in subsequent sessions, they reverted to using their fingers, perhaps because they felt safer or trusted the finger method more. Bobis (2007: 23–24) concurs by pointing out that "a child will use a multiplicity of strategies and that often these strategies will not be the most efficient ones a child is capable of performing".

Our findings in both the pilot and subsequent clubs revealed that learners primarily use non-efficient counting strategies. We saw the need to expose the club learners to a variety of more efficient strategies for solving problems in order to shift them from using less efficient methods to more efficient ones. We also saw an urgent need to increase the learners' fluency in terms of speed and accuracy. Bobis (2007) notes that getting learners from their current strategy use to more efficient strategy use is not always simple. The focus of this paper reflects on the simultaneous use of timed fluency assessments as a data-gathering tool and on the promotion of fluency using these assessments as activities in our after-school clubs.

Methodology

This paper is based on a longitudinal, qualitative case study of 12 Grade 3 learners aged between 8 and 10 participating in one after-school maths club, which ran for 28 sessions during 2012. Data collection occurred at different points over a one-year period from February to November 2012. Club learners spoke English as a second or third language, but the language of learning and teaching where the club was based was English. The participating learners, who were invited by the Grade 3 class teachers, included learners with a range of mathematical proficiencies. Participating learners were volunteers whose parents signed consent forms and for whom after-school transport arrangements could be made. In this sense, the learners were an opportunity sample. We specifically chose to work with a small group of 10 to 12 learners so that the needs of the individual clubs learners could be taken into account in the sessions. The research of our clubs and the nature of learning within it is informed by a sociocultural theory of learning and is largely interpretive and qualitative, drawing on a range of data collection methods.

The primary data collection instrument for the first research question is a diagnostic instrument focused on collecting data on learners' progress with regard to mathematical proficiency. For this instrument, we drew on the work of Askew, Brown, Rhodes et al (1997). With the authors' permission, we were able to select and adapt various items they used in assessing learners numeracy proficiency. However, the work of Wright, Martland and Stafford (2006) on mathematics recovery also provides excellent opportunities and examples of assessment items that enable one to gauge learner progress through various stages of numeracy development. Our instrument, thus, combines elements from these two research projects. The instrument was administered individually to each learner in the club in April 2012 and again in November 2012. Interviews lasted between 45 to 60 minutes and took place during school hours.

Our second data collection tool for the first research question was the timed fluency assessments, which is the focus of this paper. Other data collected include less formal data in the form of observations, journal writings, learner workings, photographs and sometimes video.

Ethical permission from the university and from the Eastern Cape Department of Education was obtained through the usual procedures and parental consent in the form of signed letters, written in the appropriate home language, was obtained. In addition, we received teacher, principal and district permission for our research. For confidentiality purposes, pseudonyms were used in subsequent publication of data. To this end, learner names have been changed. Learners were free to withdraw from the club at any time.

Literature review: Fluency

Many educators would say that fluency is about speed and accuracy (Gojak 2012). Others would say that fluency is the mastery or rapid recall and retrieval of basic facts and computational skills. Kilpatrick et al. (2001: 121) define procedural fluency as "knowledge of procedures, knowledge of when and how to use them appropriately, and skill in performing them flexibly, accurately, and efficiently". While Kilpatrick et al.'s (2001) definition focuses on procedure and methods of calculation, both mentally and with pencil and paper, Askew (2012: 54), on the other hand, talks about fluency with respect to "elements of fluency", which includes basic facts and knowing basic methods: "The point of being fluent in them [these facts] is to free up working memory when tackling a more interesting and engaging piece of mathematics". He argues that a lack of fluency in basic facts can impede conceptual understanding because certain processes take up too much working memory and attention is diverted from thinking about the bigger mathematical picture.

While there are a range of definitions for fluency, there seems to be consensus in the literature that fluency is more than being fast and accurate, and that good practice will ensure that learning, to be fluent, should be intertwined and developed along with sense making and flexible thinking (Boaler 2012; Bobis 2007; Burns 2007). This consensus coheres with Kilpatrick et al.'s (2001) recommendation that the strands of mathematical proficiency be taught using an interwoven approach.

The South African Annual National Assessment (ANA) results for 2012 (Department of Basic Education, 2012) reveal that, while the national Mathematics ANAs for Grade 3 and 4 show a 13 percentage point and 9 percentage point increase respectively from 2011, the average national scores are still under 50%. Sitting in 5th position (out of 9 provinces), the Eastern Cape performs under the national average for all grades up to Grade 9. Data collected from our teacher development project (NICLE) concurs with these results.

The argument for developing fluency in basic facts is strong, but many agree that it must be grounded in understanding. It seems worthwhile then that one of the many focus areas for the clubs should be on developing fluency in the club learners.

Fluency and timed assessments

Driven by these needs, we simultaneously used timed fluency assessments as both a research and development tool in our after-school clubs. During the 2011 pilot, we devised a series of timed fluency activities that allowed learners to improve their fluency in terms of the speed and accuracy of recalling the basic facts discussed above. Askew's (2009) article motivated the idea for these timed fluency activities which were intended to be part of the range of mental activities we promoted in the clubs.

However, after doing these timed fluency activities with learners in the pilot club, we found that they were useful as a research data collection instrument. Our primary data collection instrument (described above) was time consuming to administer. These timed fluency activities, on the other hand, were fast, took roughly six minutes to administer, gave us quick access to learners' fluency levels in the basic facts, and allowed tracking of learners' progress. We, thus, decided to give them to the learners on a regular basis as a supplementary data collection tool. In addition, by using the timed fluency activities regularly, we soon noticed their developmental and motivational power. Over time, the learners enjoyed the challenge presented by the activities and we saw that they were able to comment on their own progress.

Concerns regarding timed activities

Timed activities are, by design, time pressured and can be stress inducing for learners. Indeed, a review of literature reveals a sizable body of work that puts forward an argument against timed activities in mathematics (e.g. Boaler 2012; Burns 2007; Gilliland 2001). We understand these arguments and the anxiety and negative attitudes they can cause in learners. Both authors have heard of learners being 'turned off' maths because of frequent timed tests.

Arguments against timed tests include that learners are unlikely to be motivated by high-stress, timed tests that can cause competitiveness and a decrease in learner confidence, and engender a dislike for mathematics (Gilliland 2001). Burns (2007) argues that timed tests do not measure learners' understanding, but rather emphasise memorisation as the way to mathematical power. Nor do they guarantee that learners understand or will be able to use the facts in problem-solving situations. In spite of this, timed tests are used frequently as a tool to identify good or high-performing mathematics students to make decisions about the extent of a learner's mathematical knowledge and for determining whether a learner passes a particular grade or not.

However, many mathematics educators believe that fluency can be developed and improved with practice without the need for rote learning or drilling (Anthony & Walshaw 2009; Kilpatrick et al. 2001). One dilemma facing mathematics educators is how to develop this fluency without creating the stressful situations that are associated with timed activities. Askew (2009: 27) submits that thoughtful use of practice can help develop fluency and suggests that the development should encompass "practice and problem-solving, understanding and (appropriate) rapid recall". He suggests that, by using time trial activities with a different focus, they can be motivating for the learner. In this regard, he uses a number of different strategies to ensure that these activities are not seen as stress inducing or competitive.

Given the dual concern for research and development in working with the learners in our clubs, tension arises between the stresses that learners experience in relation to the timed aspect of the assessments and the usefulness of the means of gathering data on a regular basis. In this paper, we exemplify how we dealt with this ethical tension by utilising these assessments as a reflective tool which enabled learner buy-in of the process and increased motivation.

Our assessments

We introduced these assessment activities to the learners as a timed game. We took care not to allow any element of competition to creep in by not allowing learners to compare their performance with that of other learners. We made it clear that the results of the activities did not count towards anything and there were no consequences if a learner did not complete the activity. After completing the activities, whole group discussion focused on the strategies used by the learners. In this way, we linked the timed fluency activities to other research we have conducted on developing fluency strategies in the club sessions.

Six different individual assessments combine to make up what we call the timed fluency assessments. Each individual assessment is completed in a specified amount of time. The assessments focus on basic facts, and examples are shown in table 1 below. These examples have been trimmed to save space and are shown with dotted borders. One full example is shown for the doubling activity. We use these assessments at least once a term in each of the clubs and more frequently if learners request them.

Table 1: Description of fluency activities

Activity type	Description and sample
Doubling Full example	Double the shaded number Name ____ Date ____ 5 ☐ 4 ☐ 2 4 ☐ 6 ☐ 7 ☐ 8 ☐ 15 ☐ 11 ☐ 12 ☐ 13 ☐ 17 ☐ 14 ☐ 16 ☐ 18 ☐ 32 ☐ 25 ☐ 24 ☐ 44 ☐ 75 ☐ 90 ☐ 111 ☐ 56 ☐ 250 ☐ 3100 ☐
Add and subtract to 10	Number range up to 10 Add + | 2 | 4 3 | 5 | 5 | Minus - | 10 | 8 2 | 8 | 4 |
Add/subtract 10	Add 10 to/subtract 10 from the shaded number Add 10 | 5 | 15 2 | | 9 | Minus 10 | 10 | | 12 | 2 19 | | 25 | | 65 |

Evaluating learner progress of fluency in mathematical proficiency

For research and developmental purposes, we have developed a scoring system where each activity can yield three different scores:

1. **Actual mark**: number of answers the learners got correct out of total possible marks.
2. **Completion %**: number of answers *actually completed*. This allows us to track the *speed* at which they are answering in the given time period (giving us a *completion rate*).
3. **Accuracy %**: number of *correct* answers *out of those completed*. This allows us to track the *accuracy* of their work in that time (giving us an *accuracy rate*).

Thus, we can compare these scores and rates when the activity is re-administered to see where the progress is coming from. In some cases, learners may complete more or the entire activity (100% completion), but may not be accurate working at that speed. In other cases, learners do not complete the whole activity, but what they complete they get right (100% accuracy).

The completion rate on its own may not give a full picture of the learner's efficiency in working, as they may well guess at an answer, which would then give

them a low accuracy rate. It is important, then, to review both the completion and the accuracy scores or percentages together in order to obtain a meaningful picture of the learner's progress over time. A hypothetical example is shown in table 2.

Table 2: Example of doubling activity for a hypothetical learner

Activity	Activity out of ...	Number correct and % score	Number answered (completion %)	Number correct from those completed (accuracy %)
1st doubling activity	17	7 out of 17 = 41%	10 out of 17 (58%)	7 out of 10 correctly answered 70%
2nd doubling activity	17	10 out of 17 = 58%	15 out of 17 (88%)	12 out of 15 correctly answered 80%

Although the learner got 41% for the first doubling activity, he completed 58% of the activity in the given time, and of that 58%, got 70% correct. This gives a different perspective on the 41% overall score.

In a second use of the same activity, the learner gets 58% overall. His completion rate has increased by 30 percentage points from 58% to 88% and his accuracy rate has increased by 10 percentage points from 70% to 80%. This indicates some progress in fluency in doubling.

Ethical tension and enabling learner buy-in

As a way of dealing with the ethical tension arising through the use of these assessments, we devised and piloted a supplementary mechanism for the learners in the 2012 club to reflect on their own progress in these fluency activities. We sought to determine the extent to which this could be used with Grade 3 club learners and, in this way, explored Askew's (2009) suggestion that fluency activities, which are focused on the basic facts, can help learners monitor their own progress and provide intrinsic motivation.

After using the activities twice, we collated the results and created an individual booklet for each learner. The right side of the page showed the number of calculations in each fluency activity (table 3 in figure 1) and their individual results in each different activity (table 4 in figure 1). The number of calculations enabled the learners to work out how they performed in each activity and whether they had made progress. The left side of the page presented question prompts for the learner to reflect on (figure 1).

In the club session, before giving the learners their individual booklets, we went through a hypothetical example using the scores shown in tables 3 and 4 in figure 1. As a group, we worked through how to make sense of the scores and how to find out whether a learner had made progress. This provided a wonderful mathematical activity for the learners in a real context.

<table>
<tr><th>Left side of page: question prompts for the learner to reflect on and space to write their reflections.</th><th>Right side of page</th></tr>
<tr><td>

Which activity did you do best in?
Which activity gave you your lowest marks?
Which activity did you make the biggest improvement in?
Did you do better in March or July?
How do you feel about your progress?
Why do you think you have made progress?

</td><td>
Table 3: Number of sums for each fluency activity
<table>
<tr><th>Fluency Activity</th><th>Number of sums</th></tr>
<tr><td>Doubling</td><td>17</td></tr>
<tr><td>Halving</td><td>17</td></tr>
<tr><td>Add & Subtract 10</td><td>20</td></tr>
<tr><td>Add & Subtract 100</td><td>20</td></tr>
</table>
Table 4: Sample of learner progress in fluency activities
<table>
<tr><td>SAMPLE LEARNER PROGRESS</td><td>How many did I finish?</td><td>How many did I get right?</td></tr>
<tr><td colspan="3">Doubling</td></tr>
<tr><td>March 2012</td><td>16</td><td>16</td></tr>
<tr><td>July 2012</td><td>17</td><td>17</td></tr>
<tr><td colspan="3">Halving</td></tr>
<tr><td>March 2012</td><td>14</td><td>13</td></tr>
<tr><td>July 2012</td><td>15</td><td>15</td></tr>
<tr><td colspan="3">Add & subtract 10</td></tr>
<tr><td>March 2012</td><td>7</td><td>5</td></tr>
<tr><td>July 2012</td><td>15</td><td>14</td></tr>
<tr><td colspan="3">Add & subtract 100</td></tr>
<tr><td>March 2012</td><td>8</td><td>9</td></tr>
<tr><td>July 2012</td><td>15</td><td>14</td></tr>
</table>
</td></tr>
</table>

Figure 1: Example of learner booklet layout

Until now, the learners had no knowledge of their exact results for any of these activities because these were kept confidential as research data only. The learners were given their individual booklets and given about 15 minutes to reflect on their own scores in private and answer the questions, with support from the mentor if required. Some learners asked the mentor to write down their thoughts and they dictated these to us. We then collected the written reflections.

In order to illuminate the potential research and development opportunity that such timed activities could offer, we now share what we learnt from the use of these in one club as well as the story of one learner's experience with the timed activities and the supplemental reflection activity.

The club as a whole

In the case-study club used for this article, the timed fluency assessments were first used in March 2012 and re-administered in July. While a few learners experienced some anxiety in the first use of these, the first author noted in her research journal (31 July 2012) that there was a "positive vibe" among the club learners after the activities in July. One incident stands out. After finishing the doubling activity, one learner ran around the room shouting excitedly. Upon being questioned, she said she had "finished this time". An observation in the first author's research journal (31 July 2012) shows that she not only finished this activity, but also completed it before the allotted time. She completed 17 out of 17 and got 16 of those 17 correct. This is in stark contrast to her March effort where she only completed 8 out of 17 and got 7 correct.

An analysis of the scores for all the club learners showed that they all made progress in each of the six timed fluency activities over the four-month period. In the 13 club sessions between March and July, the club as a whole increased the average completion rate by 31 percentage points and their accuracy by 16 percentage points. The biggest increase in completion was in the add/subtract 100 activity. The biggest increase in accuracy was in the add/subtract 10 activity. (In March, the learners averaged 82% on accuracy and averaged 64% on completion rate.) In spite of the relatively high accuracy rate in March, learners did make slight increases in accuracy in July (on average from 1 to 7 percentage points across the activities). The most substantial leaps were shown in the completion rates with the range of increases being on average from 15 to 23 percentage points across the activities. These results show that learners increased in speed and in accuracy over the four-month period. We could deduce from this that all the club learners had become faster in writing their basic facts and, more importantly, that increase in speed did not have a detrimental effect on the accuracy of their answers as, in fact, their accuracy also increased slightly. This reflects a positive overall progression.

A week after the second use of the activities, we collated the results for research purposes and assembled the individual learner reflection booklets described above for four of the six activities that the learners had completed. Only four activities were given to the learners to reflect on so as not to overwhelm them with too much information.

Thembisa's story

Thembisa was part of this 12-learner club. We have purposefully selected Thembisa's story as an exemplifier for this article because she was the learner who exhibited the most stress when using these assessments. A few other learners in the club showed varying levels of stress, but not to the same degree as Thembisa. Her story is enlightening as it illuminates the way in which we dealt with the ethical tension arsing from this instrument. There is no doubt that, for this one learner, the introduction of these timed activities in this club caused some of the anxiety referred to by the authors cited earlier. The first author noted in her research journal (13 March 2012) that, during the first use of these activities in March, Thembisa was quietly tearful, displaying anxiety about not knowing an answer and she remained tearful for the remainder of the activity. We encouraged her to continue and to complete all the activities, and afterwards we held a group discussion about the purpose of the activities and a reminder of the club ethos. For example, we spoke about being supportive of one another and restated that mistakes are fine because they are learning opportunities.

Thembisa showed a less emotional attitude to the activities when they were re-done in July and was excited after the add/subtract 100 activity when she said: "just one more to go and I would have been finished". She completed 19 out of the possible 20 and got all 19 correct as shown by her scores in table 5 (in figure 2). She showed marked progress from March when she answered 7 of the possible 20 and got 6 correct. She reflected on this as her biggest improvement (see figure 2 below). In the discussion following the completion of the activities, Thembisa recalled crying in March and she said that she "was better this time" (first author's research journal, 31 July 2012).

Her results show that she also increased her speed in add/subtract 10. The first author noted in her research journal (31 July 2012) that she was also the first learner to finish the halving activity, in which she achieved 100% accuracy. In addition, she, along with another learner, completed the doubling activity before the allotted time passed.

Her reflection response (figure 2) to "What has helped you make progress?" is revealing in that she wrote "practising and undastading" (sic). She also reflects that she has put effort into her mathematics "because I have worked very hard".

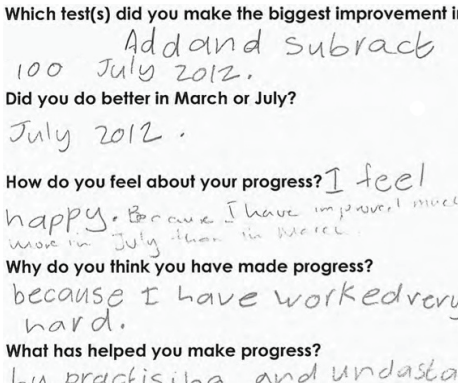

Table 5: Thembisa's progress in fluency activities

My Progress	How many did I finish?	How many did I get right?
Thembisa		
C) Doubling	**34**	**33**
March 2012	17	16
July 2012	17	17
D) Halving	**34**	**33**
March 2012	17	16
July 2012	17	17
E) Add & subtract 10	**24**	**23**
March 2012	7	7
July 2012	17	16
F) Add & subtract 100	26	25
March 2012	7	6
July 2012	19	19

Figure 2 – Thembisa's reflections and Table 5 – Thembisa's progress in fluency activities

Discussion

Learners' reflections

Thembisa's changed attitude towards the timed activities in July is worth noting. There are various possible reasons for this: By July, the learners were more comfortable with the club ethos and Thembisa perhaps had developed a degree of confidence in her mathematics as evidenced by other data (such as video and audio recordings and learner workings) collected during this particular club.

Thembisa's reflection that she has made progress by practising and understanding is revealing in that it draws together the two key aspects of the argument discussed earlier in this paper. Educators consider that learning, to be fluent, should be interwoven and developed alongside understanding and flexible thinking (or the strands of conceptual understanding and adaptive reasoning). It seems that, for her, she sees these strands as connected. In addition, her comment about working hard perhaps shows signs of her developing a positive productive disposition (the

fifth strand of mathematical proficiency) towards mathematics. Kilpatrick et al. (2001: 131) describe a productive disposition as "the tendency to see sense in mathematics, to perceive it as both useful and worthwhile, to believe that steady effort in learning mathematics pays off, and to see oneself as an effective learner and doer of mathematics". Her comment could reflect a belief and experience in steady effort paying off.

Developmental value of the timed activities

On the whole, the learners seemed to have enjoyed the activity including the reflection aspect. In 2012, we completed the first round of activities in mid-March, just three sessions after the club started. The anxiety displayed by Thembisa in March indicates that perhaps we should introduce the activities a little later in the first term so that learners have the opportunity to feel more comfortable with the club ethos and our approach to activities like these.

We designed the reflection activity to assess its usefulness with Grade 3 learners. Askew (2009) believes that this competition with oneself can be motivating for the learners. Out of the seven learners who undertook the reflection, we saw some noteworthy responses although we cannot make any judgements about whether they found the activities motivating. Some learners perhaps said what they thought we wanted to hear, but others, like Thembisa, revealed what they thought it takes to make progress in maths. In the learner reflections, the notion of 'practise' came up in about 50% of the responses when accounting for the reasons for their progress, whether via a direct reference to practise or an indirect one by mentioning doing homework or being in the club.

The fact that the reflection process also contained mathematical content was an added bonus that we had not anticipated. We also feel that the written nature of the activities allows the learners to practise putting their thoughts into written form. As researchers and mentors we also find the activities useful for gauging the overall progress of the club learners in this specific fluency aspect.

Conclusion

We have described how we came to use timed fluency assessments in our after-school maths clubs as both a research and development tool. We shared how we dealt with the ethical tension that arose from using the assessments as a research tool by utilising them in a developmental way. We argue that the supplementary learner reflections made the use of these activities more holistic for the learners in the sense that they were able to reflect on their own progress in mathematics and use mathematics to do so. This is in alignment with Askew's (2009) suggestion; thus, we have reclaimed often negatively reported timed assessments as developmental

activities. We have subsequently extended this practice in all clubs we run and continue to research their affect and effect in order to gain deeper understanding of the opportunities enabled by such activities. We have, through the paper, illuminated how such activities provide researchers with a quick way of tracking and evaluating learner numeracy progress while also providing a mechanism for learners to practise and develop their numeracy fluency.

Acknowledgement

Our numeracy research and development work is supported by the FirstRand Foundation (with the Rand Merchant Bank), Anglo American Chairman's Fund, the Department of Science and Technology, and the National Research Foundation.

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